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SECOND SYMPOSIUM ON THE THEORY AND PRINCIPLES OF MANIPULATOR DESIGN (FEBRUARY 8-9, 1968)

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ABSTRACT. The Second Symposium on the Theory and Principles of Manipulator Design is discussed. Different uses of manipulators are presented, including their use as space equipment. The main questions covered by the articles in the collection are presented, and designations are suggested for the basic elements of a manipulator.

Analysis and design methods, as well as the development of concrete manipulator schemes and designs have developed substantially in the Soviet Union, and abroad, since the first symposium, which took place at the Institute of the Science of Machines on July 4-5, 1965. /3*

The history of the creation of manipulators is barely 20-25 years old. Its beginning is connected with the demands of the atomic industry. The tempo of work in the field of creating facilities such as these is growing very rapidly, and in proportion to the expansion of these demands.

At the present time, the field of their functional purpose is expanding, with space research, utilization of the underwater world, problems of automation of production processes, medicine and prosthetics, and the number of organizations concerned with the creation of designs, devices, and systems intended for the accomplishment of a particular class of motor functions, approximately reproducing the movements of human limbs, has systematically increased.

Thus, according to information in the foreign press, scores of submarines intended for operation at shallow, medium, and great depths have already been built and are in use at the present time. No doubt most of them are equipped with manipulators. As regards space equipment, it now is possible to list at least three groups of such systems (sometimes called anthropomorphic - "human like"), the development of which is of great scientific interst and practical importance.

1. Manipulators intended for use in space and on the surface of planets. The reference here is to the simplest mechanisms and devices, as well as the

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* Numbers in the margin indicate pagination in the foreign text.

most workmanlike systems, including long-range television communication between the operator and the manipulator, and providing great possibilities for copying arm movements.

2. Devices of the "Ekzoskeleton" (exterior skeleton) type, worn by the operator, and having degrees of mobility sufficient to avoid hindering the operator's movements. They are fitted with servomotors so the operator can work under complex conditions.

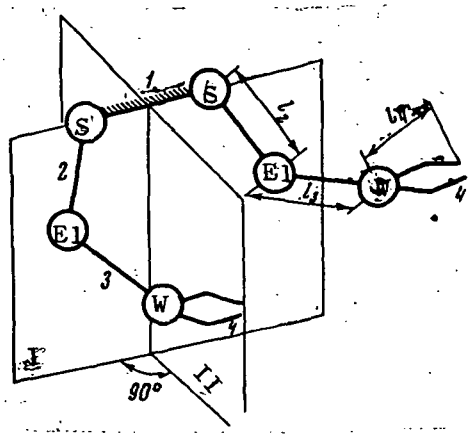
3. Pedipulators, devices intended for the reproduction of the motor functions of the legs, in connection with the creation of transport vehicles capable of moving over surfaces not readily traversable.

The scope of the scientific problems arising in connection with the development of the theory and principles of the building of anthropomorphic systems is unusually broad. There is no question that specialists working in the most diverse fields of the theory of machines can make a serious contribution to the resolution of these problems. /4

The task of the second symposium was to make certain summaries of the theoretical and experimental research that had been done in the field of manipulators. In the future it will be necessary to expand significantly the subject matter of symposiums to include other types of anthropomorphic machines and systems for controlling them.

This collection includes 18 articles setting for the basic content of the reports discussed at the symposium. These reports embrace questions of the theory and the principles of building manipulators connected with: (1) the building of manipulators and with the kinematic and dynamic properties of manipulator slave organs; (2) the transmission of control information from the master to the slave organ and the "activation" of manipulators; (3) the control of manipulators. Several questions of biomechanics and bioelectric control were discussed at the symposium. These materials also are reflected in the collection. Finally, the necessity of adhering to standard terminology was stressed by many participants in the symposium. The necessity for this will become all the more imperative in the future as investigations in the field of the theory and principles of the building of manipulators expand. Now, it seems to us, it is the right time to suggest certain designations for the basic elements of manipulator "arms"

(see drawing).



Basic elements of manipulator arms.

1 - rack, or body; 2 - shoulder; 3 - forearm; 4 - hand, or tongs; S - shoulder mechanism; E1 - elbow mechanism; W - wrist, or hand mechanism; I - frontal plane; II - sagittal plane.